

AEROLOGICAL OBSERVATIONS

By L. T. SAMUELS

Free-air temperatures for September averaged below normal at all stations and levels. (See Table 1.) In most cases the departures were of considerable magnitude. Free-air relative humidities, likewise, averaged below normal, and it is interesting to note that at Royal Center, where the departures were appreciable for both of these elements, the monthly precipitation amounted to only 0.57 inch, or 2.91 inches less than normal. Vapor pressures, in agreement with the average temperatures, were consistently below normal at all stations and levels.

The relationship between the negative temperature departures and the deviation of the resultant winds from their normal is particularly striking. (See Table 2.) It will be seen that the south component at Broken Arrow is consistently less than normal. At Ellendale the deviation from normal is especially pronounced, the resultant for the month containing a marked north component as compared with a normal south component. Moreover, the resultant velocities at this station were decidedly above normal. At Groesbeck a north component predominated instead of the normal south component, while at Royal Center there was a deficiency in the amount of the south component.

The largest deviation is found at Due West but, owing to the relatively few kite observations possible at that station during the month, a comparison was made between the resultant winds as indicated by the morning pilot-balloon observations and the normals as shown in Table 2. This revealed a preponderance of northwesterly winds as compared to a normal component from the northeast.

On the morning of the 18th, when the tropical hurricane began to recurve toward the northeast, pilot-balloon observations made at stations along its western periphery revealed strong northerly and northeasterly winds to at least 3,000 meters. A kite flight of unusual interest was made at Royal Center on the morning of the 19th, when this storm was centered over the North Carolina coast and showed an abnormally low lapse rate, 0.08°C . per 100 meters, between the surface and 3,800 meters. However, from 3,800 to 4,500 meters the lapse rate was much higher, being 0.85°C . per 100 meters. The relative humidity decreased to less than 20 per cent above 1,700 meters and to less than 5 per cent at 4,500 meters. The wind remained northeasterly throughout the 4,500-meter air column and cirrus clouds were moving from the east.

In this connection it is interesting to note that during the following 24 hours the storm changed its direction of movement from northeastward to north-northwestward and decreased considerably in intensity.

The great heights to which these tropical storms extend as compared with the extratropical storms is

further indicated by the pilot-balloon observation of New Orleans on the 18th, at which time the storm center was over Savannah, Ga. This observation showed a wind from the north to at least 7,000 meters.

TABLE 1.—Free-air temperatures, relative humidities and vapor pressures during September, 1928

TEMPERATURE (°C.)												
Altitude m. s. l.	Broken Arrow, Okla. (233 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Royal Center, Ind. (225 meters)		*Washington, D. C. (7 meters)	
	Mean	De- parture from normal	Mean	De- parture from normal	Mean	De- parture from normal	Mean	De- parture from normal	Mean	De- parture from normal	Mean	De- parture from normal
Meters												
Surface	19.9	-3.3	18.4	-5.0	12.3	-2.1	20.1	-4.0	15.2	-5.0	19.6	-1.8
250	19.8	-3.3	18.1	-4.9	12.5	-1.9	20.4	-3.1	15.1	-4.9	18.2	-1.9
500	19.0	-2.7	16.5	-4.3	12.5	-1.9	20.2	-1.9	14.4	-3.8	17.0	-1.9
750	18.2	-2.3	15.5	-3.8	12.1	-1.7	19.3	-1.5	12.9	-3.8	15.7	-2.1
1,000	17.5	-1.8	14.9	-3.3	11.1	-1.8	18.7	-0.9	11.2	-4.0	14.4	-2.4
1,250	16.9	-1.2	13.7	-3.2	10.2	-1.8	17.8	-0.6	9.7	-4.0	13.2	-2.6
1,500	16.0	-0.9	12.2	-3.4	9.1	-1.8	16.6	-0.7	8.3	-4.0	12.2	-2.5
2,000	13.6	-0.7	9.2	-3.8	6.1	-2.3	13.7	-1.2	5.9	-3.8	10.2	-2.4
2,500	10.8	-0.7	6.7	-3.5	2.7	-2.8	11.4	-1.1	3.5	-3.5	7.9	-2.6
3,000	8.2	-0.4	4.5	-3.0	-0.1	-2.6	8.4	-1.6	1.2	-3.4	5.3	-2.6
3,500	5.4	-0.2	1.1	-3.9	-1.6	-1.4	4.6	-2.8	-1.7	-3.6	2.3	-2.7
4,000	1.7	-0.8	0.7	-1.9	-5.0	-2.0	1.7	-2.9	-4.0	-3.5		
4,500					-8.6	-2.8			-8.0	-4.2		
5,000									-11.3	-4.2		
RELATIVE HUMIDITY (%)												
Surface	64	-4	76	+9	66	-2	73	-3	68	0	68	-8
250	64	-4	76	+9			70	-6	67	-1	64	-11
500	57	-9	73	+4	63	-3	65	-11	58	-9	59	-14
750	54	-10	69	0	55	-7	59	-16	57	-10	56	-15
1,000	53	-10	66	-3	51	-9	53	-18	57	-9	55	-15
1,250	50	-12	64	-5	49	-8	48	-19	56	-9	54	-14
1,500	48	-12	66	-4	45	-9	51	-13	55	-9	52	-15
2,000	45	-10	64	-2	43	-8	49	-10	45	-14	47	-15
2,500	43	-8	61	-3	46	-5	36	-17	40	-16	42	-12
3,000	40	-8	51	-9	39	-11	34	-15	38	-14	42	-9
3,500	34	-15	52	-3	27	-20	36	-10	39	-11	45	0
4,000	40	-7	48	-9	31	-14	34	-8	33	-13		
4,500					41	-2			33	-9		
5,000									34	-9		
VAPOR PRESSURE (mb.)												
Surface	15.27	-4.14	16.53	-2.66	9.42	1.93	17.59	-5.21	12.41	-3.91	16.42	-3.29
250	15.11	-4.17	16.08	-2.81			17.03	-5.04	12.25	-3.87	14.13	-3.76
500	13.16	-4.19	14.15	-2.93	9.04	2.06	15.62	-4.68	10.54	-3.88	11.91	-4.28
750	11.75	-3.90	12.76	-2.84	7.75	2.27	13.50	-4.87	9.48	-3.75	10.26	-4.36
1,000	10.98	-3.37	11.67	-2.86	6.83	2.25	11.50	-4.70	8.49	-3.52	9.23	-4.30
1,250	9.82	-3.25	10.35	-3.13	6.10	2.03	9.74	-4.56	7.55	-3.32	8.37	-3.95
1,500	8.95	-2.69	9.69	-2.93	5.22	2.05	9.44	-3.23	6.73	-3.00	7.56	-3.73
2,000	6.98	-1.92	7.38	-2.96	4.25	1.68	7.45	-2.41	4.81	-2.77	6.00	-3.10
2,500	5.33	-1.34	5.84	-2.73	3.46	1.44	4.58	-2.95	3.69	-2.19	4.46	-2.36
3,000	4.01	-1.00	4.41	-2.81	2.56	1.55	3.72	-2.16	2.89	-1.56	3.60	-2.10
3,500	2.58	-1.42	3.98	-2.25	1.69	1.60	3.34	-1.35	2.34	-1.02	2.83	-1.50
4,000	1.92	-1.05	3.62	-2.17	1.56	1.11	2.77	-0.82	1.38	-0.99		
4,500					1.36	0.74			1.27	-0.84		
5,000									1.23	-0.84		

* Naval air station.

TABLE 2.—Free-air resultant winds (m. p. s.) during September, 1928

Altitude m. s. l.	Broken Arrow, Okla. (233 meters)				Due West, S. C. (217 meters)				Ellendale, N. Dak. (444 meters)				Groesbeck, Tex. (141 meters)				Royal Center, Ind. (225 meters)				Washington, D. C. (34 meters)			
	Mean		Normal		Mean		Normal		Mean		Normal		Mean		Normal		Mean		Normal		Mean		Normal	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Meters	°				°				°				°				°				°			
Surface	S. 22 E.	1.6	S. 2 E.	3.2	N. 68 E.	1.0	N. 59 E.	2.6	N. 64 W.	2.6	N. 71 W.	0.6	N. 68 E.	1.6	S. 24 E.	1.7	S. 66 W.	1.8	S. 45 W.	1.4	N. 60 W.	0.7	N. 7 W.	0.7
250	S. 27 E.	1.9	S. 2 E.	3.3	N. 65 E.	0.9	N. 58 E.	2.5	N. 78 E.	2.8	S. 24 E.	2.4	N. 78 E.	2.8	S. 24 E.	2.4	S. 70 W.	2.0	S. 45 W.	1.6	N. 58 W.	2.3	N. 25 W.	1.1
500	S. 14 E.	2.5	S. 7 W.	4.5	N. 54 E.	0.5	N. 53 E.	2.7	N. 68 W.	2.7	S. 81 W.	0.7	N. 78 E.	3.8	S. 15 E.	3.7	S. 81 W.	3.8	S. 50 W.	3.4	N. 50 W.	2.7	N. 36 W.	1.3
750	S. 9 E.	2.5	S. 14 W.	5.3	S. 16 W.	0.4	N. 61 E.	3.1	N. 72 W.	3.0	S. 61 W.	1.3	N. 81 E.	3.1	S. 7 E.	4.0	S. 82 W.	5.0	S. 58 W.	4.4	N. 50 W.	3.5	N. 40 W.	1.7
1,000	S. 34 W.	2.7	S. 24 W.	5.2	S. 30 W.	1.8	N. 67 E.	2.8	N. 60 W.	3.4	S. 63 W.	1.8	N. 65 E.	2.7	S. 4 E.	4.2	N. 88 W.	5.5	S. 66 W.	5.1	N. 51 W.	3.8	N. 44 W.	2.7
1,250	S. 67 W.	2.5	S. 30 W.	5.0	S. 58 W.	2.7	N. 53 E.	2.7	N. 73 W.	4.1	S. 64 W.	2.6	N. 60 E.	2.8	S. 3 E.	4.3	N. 39 W.	6.0	S. 69 W.	6.2	N. 57 W.	6.6	N. 54 W.	4.4
1,500	S. 72 W.	3.0	S. 39 W.	5.0	S. 76 W.	4.2	N. 53 E.	2.0	N. 71 W.	4.6	S. 71 W.	3.4	N. 47 E.	3.8	S. 3 E.	4.2	S. 87 W.	7.1	S. 73 W.	6.8	N. 72 W.	7.9	N. 68 W.	5.7
2,000	S. 86 W.	4.0	S. 46 W.	5.7	S. 29 W.	2.0	N. 63 E.	1.8	N. 67 W.	6.0	S. 77 W.	4.8	N. 48 E.	4.2	S. 3 E.	3.8	N. 86 W.	8.2	S. 75 W.	8.5	N. 72 W.	8.7	N. 72 W.	6.5
2,500	S. 86 W.	4.2	S. 53 W.	5.4	S. 77 W.	7.5	N. 42 E.	0.9	N. 70 W.	7.2	S. 81 W.	6.7	N. 37 E.	3.8	S. 5 E.	3.7	N. 87 W.	9.7	S. 75 W.	10.2	N. 82 W.	8.7	N. 72 W.	6.5
3,000	W.	5.3	S. 51 W.	6.2	N. 83 W.	9.6	N. 41 W.	0.9	N. 67 W.	9.0	S. 87 W.	8.9	N. 20 E.	4.4	S. 3 E.	3.6	N. 88 W.	10.1	S. 74 W.	12.4	N. 79 W.	11.4	N. 71 W.	6.8
3,500	S. 68 W.	6.3	S. 53 W.	6.3	N. 77 W.	10.4	N. 1 E.	2.1	N. 57 W.	14.0	W.	10.7	N. 34 E.	5.5	S. 4 E.	2.7	N. 84 W.	8.5	S. 79 W.	11.8	N. 70 W.	10.4	N. 68 W.	7.4
4,000	S. 75 W.	7.2	S. 69 W.	7.5	N. 67 W.	12.0	N. 29 W.	3.9	N. 44 W.	15.8	N. 81 W.	12.0	N. 38 E.	5.4	S. 4 E.	2.8	N. 88 W.	8.5	S. 86 W.	10.5	N. 83 W.	14.7	N. 72 W.	8.4
4,500	S. 80 W.	6.6	S. 87 W.	8.8	N. 67 W.	14.0	N. 38 W.	8.4	N. 45 W.	14.0	N. 80 W.	13.1					N. 53 W.	9.3	N. 82 W.	9.0	S. 89 W.	10.1	N. 69 W.	8.0
5,000					N. 67 W.	14.0			N. 45 W.	14.0	N. 85 W.	14.5					N. 45 W.	18.0	N. 45 W.	18.0	N. 70 W.	8.9	N. 71 W.	7.8

WEATHER IN THE UNITED STATES

THE WEATHER ELEMENTS

By P. C. DAY

GENERAL CONDITIONS

The outstanding feature of the weather history of September, 1928, was that pertaining to the severe tropical hurricane that entered southeastern Florida near Palm Beach during the early evening of September 16, the full details of which appear elsewhere in this issue. This storm was among the most severe in the history of the Southern States, rivaling that occurring in the vicinity of Miami, Fla., September, 1926, in property damage, and greatly exceeding it in the number of deaths, mostly by drowning. Aside from the above the month was notably cool over the eastern two-thirds of the country, and there was a widespread deficiency in precipitation.

PRESSURE AND WINDS

The early days of the month showed moderately high pressure over most western districts and from the Ohio Valley northeastward to New England, with local precipitation over most Southern States from Texas northeastward to the middle Atlantic coast, some heavy falls being reported in this area. By the morning of the 3d precipitation had overspread the upper Mississippi Valley and upper Lake region, extending during the 4th into New England and the adjacent Canadian Provinces. During this period fair weather prevailed in nearly all central and western districts and, save for local rains along the south and middle Atlantic coasts from about the 5th to 7th, fair weather continued until near the end of the first decade in all parts of the country.

By the morning of the 10th cyclonic conditions had developed over the middle Great Plains and moderate to heavy precipitation occurred over considerable areas during the following three or four days from Texas northeastward to the Great Lakes and northern New England and westward over the upper Mississippi Valley into the Dakotas and adjacent Canadian Provinces. Immediately following this rain area a cyclone of moderate intensity advanced from British Columbia southeastward, reaching the lower Missouri Valley by the morning of the 14th when rain was falling over an extensive area. This cyclone moved northeastward to the

upper Lakes by the following morning and precipitation became rather general southward to the lower Ohio Valley and eastward to the lower Lakes and over much of the Province of Ontario.

Following this, anticyclonic conditions overspread most western and northern districts, continuing for several days. In the meantime, however, a strong tropical hurricane had developed over the eastern portion of the West Indies and passed directly across the island of Porto Rico during the afternoon and night of the 13th doing immense damage to property and causing large loss of life as elsewhere shown in this REVIEW.

The generally fair weather prevailing over most of the country during and preceding the last-mentioned storm was largely terminated about the beginning of the third decade when cyclonic conditions developed in the middle Plains and by the morning of the 21st low pressure was central over the upper Lakes and light rains had fallen from Colorado northeastward to the Lake Superior region. During the following 24 hours the cyclone moved northeastward and rain occurred from the Lake region to northern New England. At the same time low pressure had developed over the lower Rio Grande Valley and heavy rains had occurred in southern Texas, extending during the 23d and 24th into the southern portions of the Gulf and South Atlantic States, and continuing over the more eastern portions of that area during the following 24 hours.

The latter part of the month continued mostly fair in the central and western portions, but in the more eastern sections local showers occurred along the Gulf coast and in portions of the Ohio Valley and Eastern States.

In the far West precipitation was mainly absent until the 12th to 15th when showers, mostly light, overspread local areas from central California and portions of Nevada northward.

The sea-level pressure for the month as a whole was above normal over the central valleys and Rocky Mountains where anticyclonic conditions existed during much of the month, and it was less than normal over most eastern districts and locally in the far West.

The general distribution of the average pressure and the variations from the means of the preceding month, and the prevailing directions of the winds are shown on the various charts, while the details of the severe wind and other storms are shown in the table at the end of this section.